DISCUSSION PAPER SERIES

**Discussion paper No. 111**

# Contracting-Out of Household Waste Collection Services in Japan

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November, 2013


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# Contracting-Out of Household Waste Collection Services in Japan*

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**Abstract**

We first report three empirical findings from our survey on the contracting-out of municipal waste collection services in Japan: 1) the rate of contracting-out and the contract price are inversely related, 2) this inverse relationship tapers out as the contracting rate becomes sufficiently high, and the contract price even tends to go up as the contracting rate approaches 100%, and 3) there is a significant disparity in the contracting rates between the eastern and western parts of Japan. In order to account for these observations, we then set up a simple analytical model and examine its implications. Also, we discuss the issues that a potential hold-up situation could give rise to when the services are completely contracted out to private firms.

*Keywords*: waste collection, contracting-out, contract price, hold-up

*JEL Codes*: H42, L33

*The authors gratefully acknowledge useful comments from the seminar participants at the Victoria University of Wellington. The usual disclaimer applies.

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# 1 Introduction

Since around the 1980's, the contracting-out of household waste collection services to private firms has been widely promoted in Japan. As in many other countries, local authorities are legally responsible for the collection and disposal of household waste. In Japan, contracting-out was encouraged primarily to ease the burden of municipal governments, which were sometimes financially troubled, by reducing the operating cost of waste collection services in general. This trend was further strengthened during the 90's when Japan experienced a prolonged recession and also when the privatization and contracting-out of "blue-collar" public services, including waste collection and disposal, became even more fashionable among many developed nations.

There exist a number of empirical studies that identify significant cost savings from contracting out municipal waste collection services to private contractors. Based on the observations of 340 public and private firms in the US, Stevens (1978) indicated a cost decrease of 7 to 30% due to the contracting-out. For a sample of 205 Canadian cities, McDavid (1985) reported that public collection was 41% more expensive than private collection. Domberger et al. (1986) estimated the cost savings of 22% for contracting out household refuse collection in the UK. Reeves and Barrow (2000) showed that there is an enormous cost saving opportunity of around 45% for Ireland. Dijkgraaf and Gradus (2003) identified the cost savings of approximately 15 to 20% for the Netherlands.

In contrast with the abundance of works that report cost reduction possibilities, it is not clearly understood what are the sources of these significant cost reductions. Some argue that lower costs have been achieved at the expense of service quality and the terms and conditions of the workforce rather than greater efficiency. This is referred to as the "quality-shading hypothesis" in the literature (Domberger et al. 1997). On the other hand, others emphasize that lower costs have been achieved through higher productivity which in turn are attributed to competition (Cubbin et al. 1987).

Moreover, few focuses on what determines the political decision-makers' choice between private and public firms (Ohlsson 2003). As we will see below for the case of household waste collection services in Japan, contracting-out is not necessarily an all-or-nothing deal. That is, it is often the case that a local government contracts out a

certain portion of services to private firms but still keeps its own public operation unit despite the overwhelming evidence that contracting-out would results in significant cost reductions. To the best of our knowledge, this intermediate case has not been addressed directly in the literature.

In order to shed new lights on these issues, we conducted a survey as regards the contracting-out of household waste collection services in Japan and report its main findings in the next section. In section 3, we set up a simple analytical model and examine its implications for gaining insights into not only the way the contracting-out rate and the contract price are related but also the reason why there exists a significant regional disparity between the eastern and western parts of Japan. In the ensuing section, we briefly discuss the issues associated with a potential hold-up situation when the services are completely contracted out, and the final section concludes the paper.

# 2 Empirical Findings

For our particular purposes, unfortunately, there exist some critical problems in publicly-available data. The most comprehensive data source concerning the waste collection services in Japan is an annual official survey published by the Ministry of the Environment.[1] In their survey, however, the waste from households and that from private enterprises are not distinguishable although municipalities are only responsible for collecting household waste in practice.[2] This feature simply renders it impossible to make a legitimate comparison of the costs of household waste collection across municipalities by using the data from this survey.

In order to obtain information on the status of the contracting-out of waste collection services, in 2004 we sent out questionnaires to 695 local municipalities across Japan and received 412 responses in total. Especially, we were interested in the relationship between the extent of the contracting-out and the contract price. The data are plotted in Figure 1, excluding the ones with zero percent of contracting-out as we have no contract price

[1]The data is available at http://www.env.go.jp/recycle/waste_tech/ippan/index.html (in Japanese).

[2]It was also the case that the cost of waste collection and the other costs of waste disposal, such as the costs of incineration and landfill were reported collectively in their survey. But, this problem was corrected very recently.

for those municipalities. The curve shown in Figure 1 is the regression line, estimated by a quadratic equation with respect to the contracting rate ($rate$) with the contracting price ($price$) as a dependent variable. The estimation results based on these 244 samples can be summarized as follows:

$$price = 29,183.95 - 47,674.86 \times rate + 31,885.08 \times rate^2,$$
$$(10.915) \qquad (-5.234) \qquad (4.576)$$

where the numbers in the parentheses are associated t-values. The value of the adjusted $R^2$ is 0.122.

As we can see in Figure 1, in general there is an inverse relationship between the contracting-out rate and the contract price. Moreover, the regression line indicates that this inverse relationship tapers out as the contracting rate increases, and the contract price even moves up eventually as the contracting rate approaches 100%. In the following sections, we discuss how these phenomena can be accounted for.

The other intriguing observation from our survey data is that there are significant disparities in the contracting-out rates across municipalities, despite the widely promoted campaigns for contracting-out many blue-collar services in Japan and the overwhelming empirical evidences that the contracting-out will provide a municipality with important cost saving opportunities. Moreover, dividing the data on contracting-out rates between the eastern and western parts of Japan, we have found a notable disparity as we can see in Figure 2. Apparently, Western Japan is lagging far behind Eastern Japan in contracting out whereas we do not see any obvious differences that could account for this observation, such as the costs of waste collection services, both technologically and geographically.

We speculate that this difference is partly attributable to two major cases of social discrimination in Japan. One of them dates back to the feudal era in Japan. "Burakumin", or, an outcast group at the bottom of the Japanese social order, have historically been the victims of severe discrimination and ostracism. Many of the group members have been traditionally engaged in occupations that are associated with death, such as slaughterhouses, butchers and tanners, and those that are considered "impure". Collecting and Disposing of waste and human excrement and urine fall into the latter category.

The other group that has been severely discriminated are "Zai-nichi", or, the legal Korean residents in Japan, most of whose ancestors were forcibly brought to Japan from the Korean peninsula during the period of Imperial Japan. Due to the persistent and widespread discrimination, their occupational choices have also been extremely limited even long after WWII, and often overlapped with those traditionally occupied by Buraku-min, including waste collection services.

The issues surrounding these two particular cases of discrimination have been considered as a very sensitive subject in the post-war Japan. In particular, we have extremely scarce data as regards the status of the Buraku-min. A notable exception is a nationwide survey on their social and economic status conducted by the Ministry of Internal Affairs and Communications (1993). The data clearly reveals that the group of people categorized as Buraku-min reside far more numerously in the western part of Japan than its eastern part.[3] On the other hand, as for the legal Korean residents in Japan, there are official data published by the Ministry of Internal Affairs and Communications each year.[4] It also clearly shows that they resides quite disproportionally in the western part of Japan.

As an alleged counter-measure against the persistent discrimination, in 1975 the Diet enacted "Gotoku-ho", or, "the Act on Special Measures concerning Streamlining of Domestic Waste Disposal Business Incidental to Improvement of Sewerage". The law was intended to encourage local municipalities to provide financial and occupational supports for those who became redundant due to the spread of improved sewage systems around that time in Japan. Many of those engaged in sewage-related business joined the waste collection section of municipal governments with better incomes and greater job securities.[5] On the contrary to the term "streamlining", this particular law has been occasionally used in court as a rationale to protect the working conditions of those engaged in this line of work at both public and private enterprises, even after some of those work-

[3]Unfortunately, the data are aggregated at the prefecture level, which makes it impossible to look closer into the correlations at the municipal level

[4]The data for 2012 can be obtained at http://www.e-stat.go.jp/SG1/estat/List.do?lid=000001111233 although they are aggregated at the prefectural level as well.

[5]For instance, the mayor of Kyoto admitted that, in making recruiting decisions of waste-related workers, the city have continuously given special priority to members of Buraku-min (Nihon Keizai Shinbun 2006).

ers moved out to private contractors as the waves of privatization and contracting-out hit Japan in the 1980's.

In the next section, we argue that a higher contracting price and a lower contracting-out rate in Western Japan in general can be attributed partly to this discrimination and the associated counter-measures in recent decades.

# 3 The Model

In this section, we set up a simple analytical model with a local government and private contractors in order to gain some insights into how household waste collection services are contracted out and, especially, how the size of the contracting price is related to the degree of contracting-out in a municipality. For simplicity, we focus on a case where the local government has all the bargaining power in the contracting process by enabling the government to commit to the contracting-out price it independently chooses. Thus, we essentially assume the competitive behavior of each firm and ignore the possibility of a collusion among firms.[6]

We first consider the short-term framework where the number of contracting firms is fixed, and then, relax this assumption later. Throughout this section, we adopt the assumption of complete information.

## 3.1 The Case with a Fixed Number of Firms

Our model here is a simple two-stage game where the local government moves first by setting the contracting price and then private firms choose the amount of waste they would become responsible for. We suppose that the local government attempts to minimise the cost of collecting the total amount of household waste, $W$, that is generated during one time period, including the payment of the fee to private contractors. Hence, the

[6]We also assume away any detailed decision-making procedures, such as a type of tendering process. This assumption is rather innocuous here as we suppose complete information and the existence of multiple firms in this section. In her seminal work, Stevens (1978) comments "[a]s there are few barriers to entry in the refuse collection industry, the price charged by private firms is expected to tend to the competitive solution". However, the combination of asymmetric information and a small number of firms could cause an important issue as we discuss in section 4.

government is concerned solely about the size of its own expense to collect the total municipal waste.[7] The government can either collect the waste on its own or contract out the task to contractors.

The government has the technology that is represented by a cost function of a quadratic form, $c_G(w) = \frac{1}{2}\alpha w^2 + \beta$, where $\alpha$ and $\beta$ are positive constants and $w$ is the amount of waste the government itself collects. If each firm contracts the amount of waste given by $q$ and there are $N$ firms in the market, we have $w = W - Nq$. The local government knows that those contractors have a different type of collection technology than that of the government and it is represented by the following cost function: $c_F(q) = \frac{1}{2}\gamma q^2 + \eta$, where $\gamma$ and $\eta$ are positive constants. Throughout this section, we assume that this cost function is uniform across all the firms in one municipality and completely and correctly known by the local government. We suppose $\alpha > \gamma$, which reflects the fact that private firms typically incur much smaller operating cost in the collection activities.[8] Also, as for the lump-sum parts of the cost functions, we suppose $\beta > \eta$, as a significant portion of those engaged in the waste collection service are usually employed on a long-term basis at both public and private enterprises, and, as public servants, public workers are generally paid at a much higher rate than those employed by private firms throughout Japan.[9]

Whereas the values of $\beta$ are almost the same since the wages of local public servants in Japan are almost perfectly regulated by the central government,[10] the actual values of $\eta$ could vary significantly across municipalities. We consider that policy interventions in the waste collection markets are reflected, most importantly from our analytical viewpoint, by a larger lump-sum cost of waste collecting operation. As we mentioned in the previous section, there is a special objective that the "Gotoku-ho" in Japan has intended to serve

[7] As the government's objective in choosing whether to privatize its service or not, Sappington and Stiglitz (1987) mention three criteria; economic efficiency, equity, and rent extraction. Our assumption here does not address the second and third criteria at all, and is even different from the first objective in that the local government only cares about the size of its total expense.

[8] Using the data on prices of trucks used for waste collection in Sweden, Ohlsson estimated that private firms pay 10-15% less than public enterprises.

[9] Based on his own interviews as regards the working conditions of workers engaged in waste collection services in several cities in the vicinity of Osaka, Japan, Miki (2004) reports that an public-sector employee is generally paid about 70-80% more than its private counterpart with much stronger job securities. As for other capital goods,

[10] Certain regional disparities, such as price levels, are taken into account, but to a very small extent.

implicitly, i.e., to protect the working conditions of a certain group of people who are traditionally engaged in this line of work even with private contractors. As the workers are generally on long-term labour contracts, a larger value of the lump-sum cost of doing business for a private firm is partly an indication that the share of this group is greater and such an intent of the law is more strongly upheld in such a municipality.

The local government tries to solve the following expenditure minimisation problem by choosing the contracting price, $p$:

$$\min_{p} pNq + \frac{1}{2}\alpha \left(W - Nq\right)^2 + \beta, \tag{1}$$

where the first term is the total payment of the contracting fee, and the sum of the second and third terms is the collection cost. In the second stage, each contractor observes the choice of $p$ by the government in the first stage, and tries to maximise its own profit as a price-taking firm. The profit of the contractor, $\pi$, is given by:

$$pq - \left(\frac{1}{2}\gamma q^2 + \eta\right). \tag{2}$$

The first-order condition for the profit maximisation is:[11]

$$p - \gamma q = 0 \Rightarrow q = \frac{p}{\gamma}. \tag{3}$$

Correctly anticipating each firm's choice of $q$ in (3), the local government chooses $p$ so as to solve (1) with this particular value of $q$. Then, the first-order condition is:

$$2p^* \cdot \frac{N}{\gamma} + \alpha \left(W - \frac{p^* N}{\gamma}\right)\left(-\frac{p^* N}{\gamma}\right) = 0 \;\Rightarrow p^* = \frac{\alpha\gamma}{2\gamma + \alpha N} \cdot W, \tag{4}$$

where $p^*$ signifies the subgame-perfect Nash equilibrium level of the contracting price. We can easily confirm that $p^*$is increasing in $\alpha$ and $\gamma$, respectively. Inserting (4) into $p$ in (3), we have:

$$q^* = \frac{\alpha}{2\gamma + \alpha N} \cdot W, \tag{5}$$

where $q^*$ is the equilibrium amount of the waste collected by one firm. Finally, the "rate

[11]The second-order conditions hold throughout this paper.

of contracting-out" in this subgame-perfect Nash equilibrium, $r^*$, can be found as:

$$r^* = \frac{N \cdot q^*}{W} = \frac{\alpha N}{\alpha N + 2\gamma}. \tag{6}$$

As is shown in (6), the equilibrium contracting-out rate does not depend on $W$, i.e., the total amount of waste. Thus, the size of a municipality itself does not make a difference in the chosen contracting rate.

On the other hand, we can easily obtain the value of $q$ that minimises the social cost of collecting the total waste, denoted by $q^O$, as:

$$q^O = \frac{\alpha}{\alpha N - \gamma} \cdot W. \tag{7}$$

By comparing (5) and (7), we can immediately obtain the following proposition:

**Proposition 1.** *It is always the case that the equilibrium contracting rate is too small from a welfare-maximising viewpoint.*

This result is obvious by just looking at the objective function of the government, (1), which is its own total expense and not the social cost of waste collection. In order to obtain the efficient outcome, the central government could provide a certain incentive scheme that moves $q^*$ toward the value of $q$ that satisfies (7) so that the local government's objective function would become perfectly aligned with the social cost minimization problem. For instance, the subsidy of $\frac{\alpha\gamma NW}{(\alpha N-\gamma)(\alpha N+2\gamma)}$ for each unit of the waste contracted out to a private firm could achieve this first-best outcome. However, such a scheme may be politically difficult to implement. Thus, this observation provides a rationale for a society to promote the contracting-out of municipal waste collection service from the social welfare perspective.

Based on the results above, furthermore, we can obtain the following proposition.

**Proposition 2.** *A smaller marginal cost of operation for private firms implies a smaller contract price and a higher contracting-out rate in the equilibrium.*

*Proof.* From (4) and (6), we can obtain the following comparative statics results with respect to the firm's marginal cost, $\gamma$:

$$\frac{\partial p^*}{\partial \gamma} = \frac{\alpha^2 N}{(2\gamma + \alpha N)^2} > 0, \tag{8}$$

$$\frac{dr^*}{d\gamma} = \frac{-2\alpha N}{(2\gamma + \alpha N)^2} < 0. \tag{9}$$

Thus, a smaller $\gamma$ leads to a smaller $p^*$ as well as to a larger $r^*$. **Q.E.D.**

This result implies that a variation in the marginal cost of collecting waste by contractors in different municipalities could be a driving force behind the empirical finding that the $p^*$and $r^*$are inversely correlated.

In addition, a similar relationship can be obtained as regards a variation in $N$, which is the number of private contractors in a market.

**Proposition 3.** *An increase in the number of contractors implies a smaller contract price and a higher contracting-out rate in the equilibrium.*

*Proof.* From (4) and (6), we can easily obtain the following comparative statics results:

$$\frac{\partial p^*}{\partial N} = \frac{-\alpha^2 \gamma W}{(2\gamma + \alpha N)^2} < 0, \tag{10}$$

$$\frac{dr^*}{dN} = \frac{2\alpha N}{(2\gamma + \alpha N)^2} > 0. \tag{11}$$

Thus, an increase in $N$ leads to a smaller $p^*$ as well as to a larger $r^*$. **Q.E.D.**

Therefore, a variation in the numbers of contractors in respective markets can also induce the inverse relationship between $p^*$and $r^*$.

In a sense, the last result implies that a more open market, in terms of a greater number of operating firms, would witness a higher contracting-out rate and a lower price. In our particular context where, even in the long run, the operating cost involves a lump-

sum component, such as somewhat regulated wages for workers on long-term contracts, however, the openness of a market would be represented more fundamentally by the magnitude of this lump-sum cost. We can observe from (4) and (6) that, in this case with a fixed number of firms, the lump-sum cost of operation for private firms, $\eta$, do not play any role in the determinations of $p^*$ and $r^*$ because it is considered sunk in the short run. Below, we endogenise the value of $N$ by considering a long-run equilibrium of this market and offer an alternative explanation for the negative correlation between the contract price and the rate of contracting-out.

## 3.2 The Case with an Endogenous Number of Firms

In this subsection, we extend the model above by endogenising the number of contractors, $N$. Here, we simply apply the zero-profit condition in order to determine the long-term equilibrium number of the firms in a market. Given the equilibrium values of $p^*$and $q^*$, the profit of each contractor in this subgame-perfect Nash equilibrium, $\pi^*$ is:

$$\pi^* = \left(\frac{\alpha\gamma}{2\gamma + \alpha N}\right)^2 \cdot \frac{W^2}{\gamma} - \frac{\gamma}{2} \cdot \left(\frac{\alpha}{2\gamma + \alpha N}\right)^2 \cdot W^2 - \eta. \tag{12}$$

By setting $\pi^* = 0$ and solving for $N$, we obtain the equilibrium number of contractors operating in this market, $N^{**}$, as:

$$N^{**} = W\sqrt{\frac{\gamma}{2\eta}} - \frac{2\gamma}{\alpha}. \tag{13}$$

Now, we substitute (13) into $N$ in (4) and (6) to obtain the equilibrium contract price ($p^{**}$) and contracting-out rate ($r^{**}$) in the case where that the number of contractor is endogenously determined by the zero-profit condition. After some manipulations, these values can be obtained as follows:

$$p^{**} = \sqrt{2\gamma\eta}, \tag{14}$$

$$r^{**} = 1 - \frac{2\sqrt{2\gamma\eta}}{\alpha W}. \tag{15}$$

Based on these results, we can derive the following proposition that indicates a varia-

tion in $\eta$ can indeed be a cause of the inverse relationship between the rate of contracting-out and the contracting price.

**Proposition 4.** *A smaller lump-sum cost of waste collection by a contractor implies a smaller contract price and a higher contracting-out rate in the long-run equilibrium.*

*Proof.* From (14) and (15), we can easily obtain the following comparative statics results:

$$\frac{\partial p^{**}}{\partial \eta} = \sqrt{\frac{\gamma}{2\eta}} > 0, \tag{16}$$

$$\frac{dr^{**}}{d\eta} = -\frac{1}{\alpha W} \cdot \sqrt{\frac{2\gamma}{\eta}} < 0. \tag{17}$$

Thus, a smaller $\eta$ leads to a smaller $p^{**}$ as well as to a larger $r^{**}$.**Q.E.D.**

Thus, a larger lump-sum cost of waste collection by a private firm creates a taller barrier against a potential firm's entering this specific market as this cost is essentially a variable cost in the long run and incurred immediately as a firm enters the market. In some municipalities in Japan, a significant share of a larger $\eta$ could stem from additional labour-related costs due to the specific circumstances surrounding the waste collection business. One of the most notable examples would be the discrimination-related costs in certain municipalities mainly in the western part of Japan.

# 4 Discussion

Whereas we have identified several potential sources that could lead to the inverse relationship between the contract price and the rate of contracting-out, we have not discussed yet why the contract price goes up as the rate becomes sufficiently close to 100% as it appears to be the case from the plotted data in Figure 1. To the best of our knowledge, this observation has never been reported in previous empirical studies, much less investigated analytically. As we mentioned in Introduction, those empirical studies have

mainly focused on the comparisons of the collection costs between fully-public and fully-contracted-out entities and, in our opinion, left some intriguing phenomena, such as this one, unexplored.

Unfortunately, the model in the previous section is not qualified to account for this observation mainly because of its simplicity. Instead of revising the model by incorporating some additional traits into the current model, here we merely discuss one possibility that causes this particular observation: a kind of hold-up situation.[12] Household wastes need to be hauled away within a fairly short time-frame, usually weekly or twice weekly, for reasons of general health and sanitation. Once a municipal government fully contracts out its waste collection services to private firms and gets rid of its internal unit entirely, over time it could lose certain relevant information as regards the costs of collection in one specific municipality. This could create an environment where a private firm is able to make a better case for a higher contract price, leading to a shift in bargaining positions toward the private firm's advantage. A private firm might even threaten to go on a strike unless the contract price is raised.[13] Such a hold-up situation would be more likely to pose a serious problem with a fewer number of potential contractors in a market, because then market forces could not completely wipe out the effect of such a false claim and also because firms are easier to collude to raise a tender price. Domberger and Jensen (1997) write, "[c]ontracting out is likely to be more (less) successful whenever the availability of competitive supply in the market, both actual or potential, is large (small)". The argument here is yet another support for this claim.

In the presence of this possibility, a more sophisticated local government might fear the contingency that it is held up by contractors and decide to keep a larger portion of waste collecting operation internally than its simple expenditure-minimisation would justify. As we can see in Figure 1 and 2, there are many municipalities that choose quite high percentages of contracting-out, but still retain a fairly small share of internal provision of waste collection services. The hold-up possibility that they could potentially face is one

[12]This is a completely different kind of hold up situation that has been discussed in the literature. Domberger and Jensen (1997) mentioned that the public ownership of the assets, such as specialized vehicles, and the existence of "relation-specific investments" that are sunk expenditures by the contractor results in under-investment, following a more general argument by Hart (1995).

[13]On the contrary, civil servants are banned from striking in Japan.

probable rationale for cutting down on the rate of contracting-out for municipalities.

From a viewpoint of social welfare, though, the potential existence of such an incentive would provide an additional reason why the contracting-out needs to be encouraged even more strongly because, while the hold-up issue can discourage a local government to contract out, it will not directly change the actual cost of collection services as long as the amount of waste is fixed. That is, from a society's perspective as a whole, a local government should ignore this issue altogether, along with revising its expenditure-oriented objective.

# 5 Concluding Remarks

In this paper, we first reported the three main findings of our survey on the contracting-out of household waste collection services in Japan: 1) the rate of contracting-out and the contract price are inversely related, 2) this inverse relationship tapers out as the contracting rate becomes sufficiently high, and the contract price even goes up as the contracting rate approaches 100%, and 3) there is a significant disparity in the contracting rates between the eastern and western parts of Japan. Then, by setting up a simple analytical model, we demonstrated that the the first and third observations can be attributed to a variation in the lump-sum costs of conducting waste collection services by private contractors. Also, we briefly discussed that the second observation can be a result of a potential hold-up situation that could arise when the services are completely contracted out to private contractors.

We can derive two main policy implications from this study. Both the expenditure-saving motive of a municipal government and the potential hold-up issue discourage the government from contracting out its waste collection services, resulting in an insufficient rate of contracting from the social welfare perspective. In order to counter these effects, a stronger support from the central government, even the provision of a subsidy for contracting-out, would be justified. Our analysis also indicates that the observation that the rates of contracting-out in Western Japan is lagging behind those in Eastern Japan in general is partly attributable to the persistent discrimination against the two particular groups. According to our analytical result, the abolishment of the discrimination would

lead to a lower contract price as well as to a higher rate of contracting, which in turn contributes to lowering the social cost of collecting household waste.

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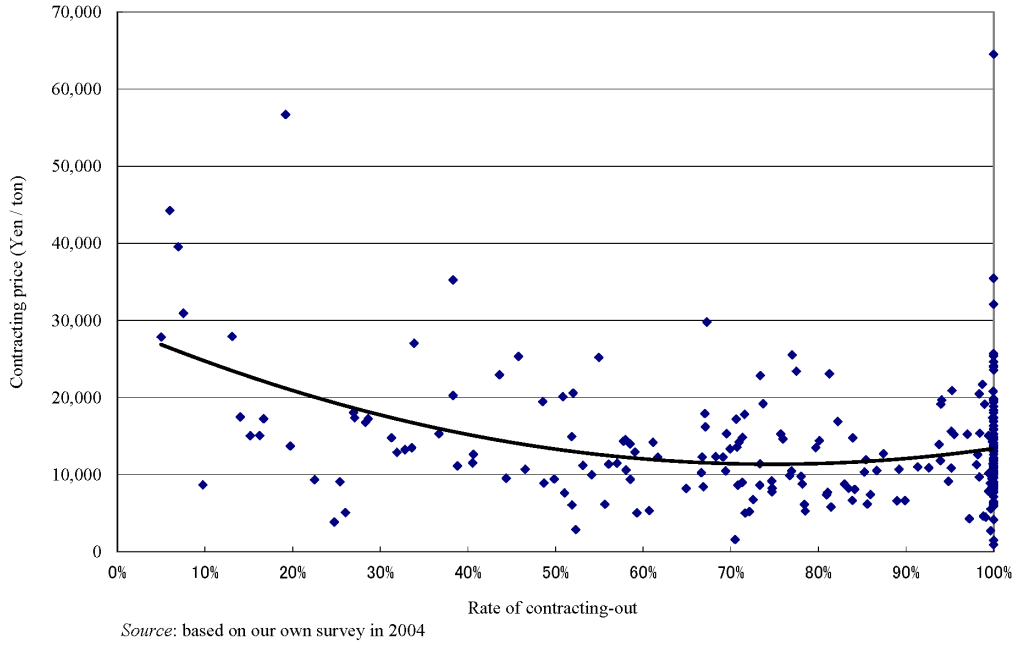
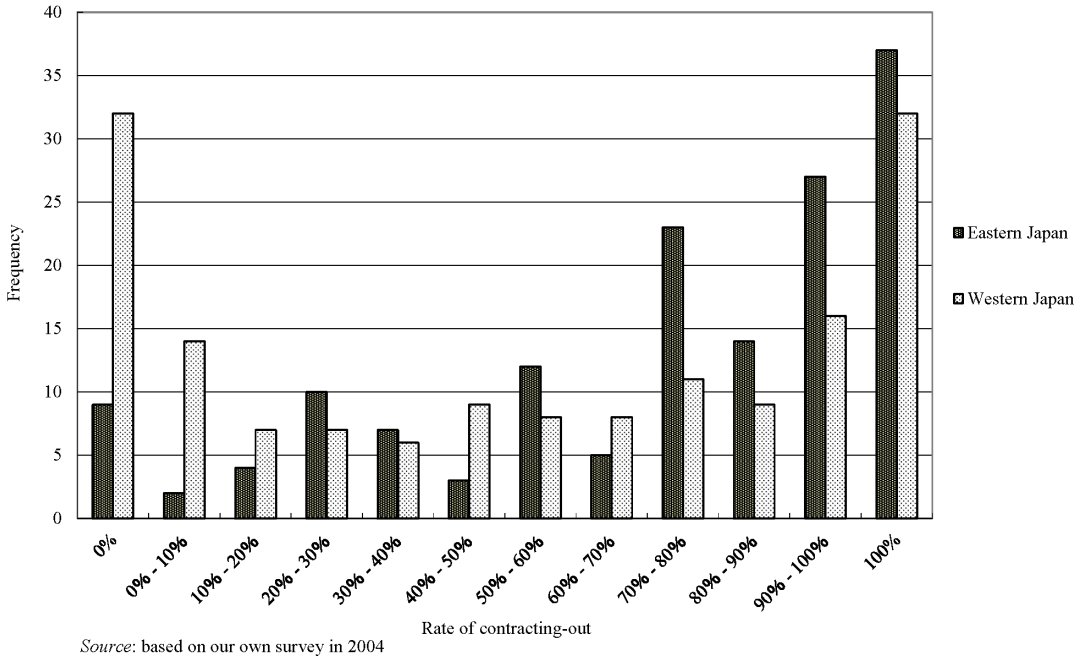



*Source*: based on our own survey in 2004

Figure 1: The contracting-out rate and the contract price in Japan




*Source*: based on our own survey in 2004

Figure 2: Regional difference in the contracting rates in Japan